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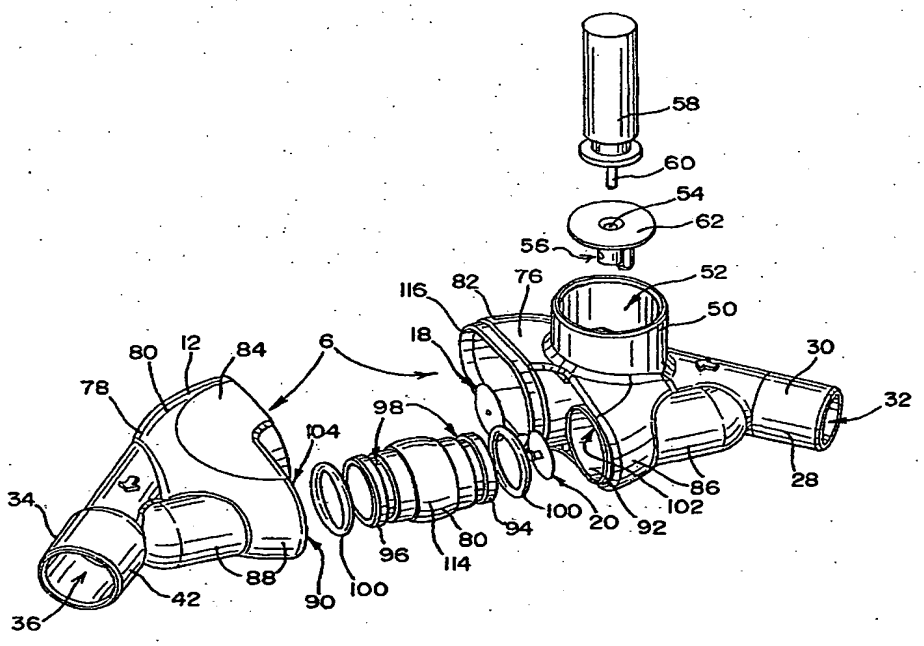

(57) Abstract: A ventilator circuit for use in administering medication to a patient includes a housing, a one-way inhalation valve and a one-way exhalation valve. A metered does inhaler receptacle is in fluid flow communication with an interior space of the housing holding chamber. An exhaust conduit communicates between input and output passageways disposed on opposite sides of the interior space.

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VENTILATOR CIRCUIT AND METHOD FOR THE USE THEREOF

FIELD OF THE INVENTION

[0001] The present invention relates generally to a ventilator circuit, and in particular, to a ventilator circuit having inhalation and exhalation valves.

BACKGROUND

[0002] Patients have certain conditions that can be treated with medicaments dispensed in an aerosol and administered to the patient by inhalation. In one format, the aerosol and medicaments are contained in a container, and dispensed in metered, or measured, dosages with an inhalation device. For example, as shown in U.S. Patent No. 6,435,177, entitled AEROSOL MEDICATION DELIVERY APPARATUS AND SYSTEM, and assigned to Trudell Medical International, the same Assignee as the present application, a holding chamber can be used to facilitate the administration of the medication to a patient. Typically, when used in a ventilation circuit, the holding chamber is introduced into the ventilation circuit just prior to the administration of the medication and is then removed.

SUMMARY

[0003] In one aspect, a ventilator chamber, for use in a ventilator circuit that administers medication to a patient, includes a housing, a one-way inhalation valve and a one-way exhalation valve. The housing includes a chamber defining an interior space having an input opening and an output opening, an input port defining an input passageway communicating with the input opening and adapted to receive a flow of gases from a ventilator intake line, a pressurized metered dose inhaler receptacle in fluid flow communication with the interior space, an output port defining an output passageway and communicating with the output opening; and an exhaust conduit communicating between the output passageway and the input passageway of the output port and said input port respectively. The one-way inhalation valve is positioned to permit one-way flow from the input passageway of the input port to the interior space of the chamber housing. The one-way

exhaust valve is located in the exhaust conduit and is adapted to prevent a backflow of gas from the exhaust conduit into the output passageway.

[0004] In one embodiment, the input port and the output port are oriented in a substantially non-parallel relationship. In one embodiment, the input port and the output port are oriented in a substantially perpendicular relationship. This relationship allows for better positioning of the apparatus relative to the ventilator and patient.

[0005] In another aspect, a ventilator circuit for administering medication to a patient includes the chamber housing. The exhaust conduit opens directly into the input passageway at an exhaust opening formed in the input port. The one-way inhalation valve is positioned downstream from the exhaust opening. The one-way exhaust valve is located in the exhaust conduit and is adapted to prevent a backflow of gas from said exhaust conduit into said output passageway.

[0006] In another aspect, ventilator circuit includes a chamber housing defining an interior space, a one-way inhalation valve operative to permit a flow of gases into an interior space of said chamber housing, an inhalation conduit communicating with an output end of a chamber and an exhaust conduit communicating with the inhalation conduit. The exhaust conduit includes a viewing window, which permits the user or caregiver to monitor the patient's breathing cycle. A one-way exhaust valve is located in the exhaust conduit and is adapted to prevent a backflow of gas from the exhaust conduit into the inhalation conduit. At least a portion of the one-way exhaust valve is visible through the viewing window of the exhaust conduit.

[0007] In another aspect, a medication delivery device includes a holding chamber having an input end and an output end and a metered dose inhaler receptacle in communication with the input end of the holding chamber. The receptacle includes at least first and second wells shaped to receive respectively a valve stem of first and second metered dose inhalers. The first and second or orifices may have two different shapes respectively if two different medications are being used.

[0008] In yet another aspect, a method of assembling a ventilator chamber for use in a ventilator circuit includes providing a first chamber component defining at least a portion of a chamber, at least a portion of an input port and at least a portion of an exhaust conduit, providing a second chamber component defining at least a portion of the chamber, at least a portion of an output port and at least a portion of the exhaust conduit and providing a connector component defining at least a portion of the exhaust conduit. The method further includes disposing the connector component between the first and second chamber components and connecting the first and second chamber components.

[0009] In yet another aspect, a method of administering a medication to a patient includes transmitting oxygen from a gas source through an inlet line, a holding chamber and an inhalation conduit to the patient during an inhalation sequence of a breathing cycle. The method further includes introducing medication into the holding chamber, preventing a substantial transmission of an exhaust gas into the holding chamber during an exhalation sequence of the breathing cycle, and transmitting a substantial portion of the exhaust gas into an exhaust conduit during the exhalation sequence. The method further includes preventing a substantial transmission of the exhaust gas from the exhaust conduit into the inhalation conduit during subsequent inhalation sequences of subsequent breathing cycles, and transmitting the exhaust gas from the exhaust conduit directly into the inlet line.

[0010] The various embodiments and aspects provide significant advantages over other ventilator circuits. In particular, the inhalation valve creates a back pressure, which prevents a substantial portion of an exhaust gas from entering the chamber. In addition, the exhaust valve also operates to prevent the exhaust gases from reentering the inhalation conduit from the exhalation conduit. In this way, the chamber can remain in the ventilator circuit even when not being used to administer a medication.

[0011] In addition, in one embodiment, the housing, with its integrated input port, output port and exhaust conduit, can be easily manufactured and installed in the ventilator circuit without the need for an additional exhaust tube or connector.

Likewise, the three-piece housing, with its three components, can be easily assembled. In addition, the orientation of the input and output ports are perpendicular to allow for the positioning of the ventilator circuit beside the patient and to connect the ventilator circuit to the endotracheal tube without the need for an elbow connector.

[0012] The metered dose inhaler receptacle also provides advantages with its two wells. For example, the same chamber can be used with different medicament containers and formulations without having to remove the chamber from the circuit.

[0013] The foregoing paragraphs have been provided by way of general introduction, and are not intended to limit the scope of the following claims. The presently preferred embodiments, together with further advantages, will be best understood by reference to the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIGURE 1 is a top view of one embodiment of a ventilator chamber.

[0015] FIGURE 2 is a perspective view of the ventilator chamber shown in Figure 1.

[0016] FIGURE 3 is an exploded view of the ventilator chamber shown in Figure 1.

[0017] FIGURE 4 is a top, cross-sectional view of the ventilator chamber shown in Figure 1 during an inhalation sequence of a breathing cycle.

[0018] FIGURE 5 is a top, cross-sectional view of the ventilator chamber shown in Figure 1 during an exhalation sequence of a breathing cycle.

[0019] FIGURE 6 is a perspective view of a portion of a ventilator circuit.

[0020] FIGURE 7 is a perspective view of a connector component.

[0021] FIGURE 8 is a top view of an alternative embodiment of a ventilator chamber.

[0022] FIGURE 9 is an exploded perspective view of the ventilator chamber shown in Figure 8.

[0023] FIGURE 10 is a top view of another alternative embodiment of a ventilator chamber.

[0024] FIGURE 11 is a perspective view of the ventilator chamber shown in Figure 10.

[0025] FIGURE 12 is an exploded view of the ventilator chamber shown in Figure 10.

[0026] FIGURE 13 is a perspective view of another alternative embodiment of a ventilator chamber.

[0027] FIGURE 14 is a cross-sectional view of the ventilator chamber shown in Figure 13.

[0028] FIGURE 15 is an end view of the output component of the ventilator chamber shown in Figure 13.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0029] Referring to FIGS. 1-6, a ventilator circuit **2** is shown as having a ventilator chamber **4** positioned in the inspiratory flow path from the ventilator 14 to the patient. The ventilator chamber **4** includes a housing **16** having a holding chamber **12** defining an interior space 6, an input opening 8 and an output opening **10**. In one embodiment configured for an adult, the holding chamber **12**, and in particular the interior space 6, preferably has a volume of between about 50 ml and 250 ml, more preferably between about 60 ml and 100 ml, and most preferably about 85 ml, although other volumes not specifically enumerated herein are suitable. In an alternative embodiment configured for an infant, child or younger patient, the volume of the interior space is between about 20 and 60 ml, and preferably about 35 ml.

[0030] Preferably, the holding chamber **12** is made of a clear plastic, although it can be non-transparent in certain embodiments. Various aspects of the holding chamber are further disclosed and described in U.S. Patent No. 6,435,177, which is hereby incorporated herein by reference in its entirety. In one embodiment, the holding chamber is made from an anti-static material, as disclosed for example

and without limitation in U.S. Patent Application No. 10/821,260, filed April 8, 2004, which is hereby incorporated herein by reference in its entirety. In one embodiment, the holding chamber is antistatic, meaning it has a surface resistivity of less than about 10E12 ohm/sq., and preferably between about 10E10 and about 10E12 ohm/sq. Preferably the anti-static holding chamber is made of plastic. The holding chamber **12** has a one-way inhalation valve **18** positioned upstream of the interior space **6**, and a one-way exhaust valve **20** positioned downstream of the interior space **6**. As used herein, "upstream" and "downstream" refer to the direction of the flow of gases during the inhalation sequence of a breathing cycle. As used herein, the terms "exhaust" and "exhalation" are interchangeable.

[0031] The ventilator circuit further includes a ventilator intake line **26**, which forms part of an inhalation conduit that runs between the ventilator and the holding chamber. The intake line **26** carries oxygen from the ventilator **14** to a Y-connector **24**, which is also connected to an exhaust line **22**. The Y-connector **24** also is connected to an input end **28** of an input port **30** of the ventilator housing. The input port defines an input passageway **32** in communication with the input opening **8** of the housing chamber. The terms "communicate," "communicates," "communication," and variations thereof, refer to the conveyance of a fluid, e.g., liquid or gas, between two components or locations, whether directly or indirectly, for example by way of another component.

[0032] The housing further includes an output port **34** having an output passageway **36** in communication with the output opening **10** of the holding chamber **12**. As shown in FIGS. 1-6, the input port **34** and output port **30**, and the respective input and output passageways **28, 34**, each defined by axes **38, 40** respectively, are configured in a non-parallel relationship, and in one embodiment in a substantially perpendicular relationship.

[0033] In various embodiments, the output port **34** of the ventilator chamber can be configured with a narrow orifice in the output passageway, as disclosed for example in U.S. Provisional Patent Application No. 10/979,743, filed November 2, 2004 and entitled AEROSOL MEDICATION DELIVERY APPARATUS WITH NARROW ORIFICE, which is hereby incorporated by reference herein. In

one embodiment, the narrow orifice is formed integrally in the output port. In another embodiment, the narrow orifice is formed in an adapter secured to the ventilation chamber **4**. The narrow orifice, when formed for example in an adapter, is positioned between the output port **34** and a user interface element (not shown) connected thereto. In one exemplary embodiment, the narrow orifice has a cross-sectional area of less than about 60 mm^2.

[0034] The output port **34** has an end portion **42** configured to mate with a patient or user interface element, configured for example as a mask, mouthpiece or endotracheal tube. The patient interface element completes the inhalation conduit. The patient interface element preferably includes an end portion configured to be disposed in or around the end portion **42** of the output port. Alternatively, the patient interface element can be integrally formed with the output port.

[0035] The housing further includes an exhalation conduit **44** that extends between and is connected to the input and output ports **30, 34**. The exhalation conduit defines a passageway **46** that communicates with the input and output passageways **32, 36**. In one embodiment, the exhaust conduit passageway **46** opens directly into the input passageway through an exhaust opening.

[0036] A pressurized metered dose inhaler (MDI) receptacle **50** is formed on a top of the housing **16**. The receptacle **50** defines a socket or recess **52** shaped to receive the end portion of a medicament container **58** and a well **54** formed in the bottom of the recess. The well **54** is shaped to receive and frictionally engage a valve stem **60** extending from the end of the container. The well **54** communicates with an orifice **56**, which opens into the interior space of the chamber. In one embodiment, the well **54** and orifice **56** are defined by a discharge nozzle **62**, which is removably secured in the bottom of the receptacle. An arm or locator member extends from the nozzle to ensure the proper orientation of the nozzle and also to prevent the inhalation valve from dislodging and entering into the inhalation tube leading to the patient. Since the nozzle is removeable in one embodiment, different nozzles can be exchanged and used with the same ventilation chamber **4**, even without having to remove the ventilation chamber **4** from the ventilator circuit **2**. It should be understood that the receptacle can be

configured to connect to and support medication containers or systems other than the disclosed MDI.

[0037] Referring to the embodiment of FIGS. 8 and 9, the discharge nozzle **64** has a plurality (meaning more than one) of wells **54, 66** and respective orifices **56, 68**. The recess **5** and nozzle have an obround shape, rounded at opposite ends to accommodate a container in each well. In one embodiment, the wells are spaced such that the containers can be mounted simultaneously in tandem, while in another embodiment they must be mounted sequentially. In the illustrated embodiment, the nozzle has a first and second well **54, 66**. The wells **54, 66** communicate with respective orifices **56, 68**, which have different shapes. The different orifices accommodate different types of medication. In particular, the size of the orifice will influence the size of the aerosol particle. For certain medications targeted for the deep part of the lungs, a particle size of about 4.7 microns is desirable. Other medications target the upper part of the lungs, and may therefore have a particle size desirably greater than 4.7 microns. In one embodiment, a first orifice is about 11 microns, suitable for example and without limitation for corticosteroid medication, and the second orifice is about 14 microns, suitable for example and without limitation for bronchodilator medication.

[0038] It should be understood that the wells can also have a different shape top accommodate different shapes of valve stems. It should be understood that the wells can have the same shape, with the orifices being configured differently for different formulations, that the orifices can have the same shape with the wells having a different shape, or with both the orifices and wells having a different shape. It should be understood that the phrase "different shape" means a different cross-sectional configuration, for example and without limitation circular or polygonal, or a different cross-sectional area, for example and without limitation circular orifices having different diameters.

[0039] In the embodiments of FIGS. 1-6, 8 and 9, the orifice(s) **56, 68** is positioned adjacent or proximate the input opening **8** and opens in a downstream direction **72** into the interior space **6** of the holding chamber. Alternatively, as

shown in FIGS. 10-12, the MDI receptacle is positioned adjacent or proximate the output opening **10**, with the orifice opening or directed in the upstream direction **74** into the interior space **6** of the chamber.

[0040] As shown in FIGS. 1-11, the ventilator chamber preferably includes three components **76, 78, 80**. A first component **76** forms and defines the input port **30**, a portion **82** of the holding chamber (and interior space thereof) and a portion **86** of the exhalation conduit. A second component **78** forms and defines the output port **34**, a portion **84** of the holding chamber (and interior space thereof) and a portion **88** of the exhalation conduit. As shown in the respective embodiments of FIGS. 1-7 and 9-11, the MDI receptacle **50** can be configured or formed on either the first or second component **76, 78**. In another embodiment (not shown), both the first and second components have a MDI receptacle formed thereon.

[0041] A third component **80**, or connector component, defines in part the exhalation conduit **44**. The connector component **80** extends between exhaust openings **90, 92** formed in the first and second components respectively. In one embodiment, the connector component **80** is preferably clear or see-through, and defines a viewing window in the exhalation conduit. The connector component is generally cylindrical in nature and has opposite ends **94, 96**. Each end includes an annular or circumferential groove **98** formed around the periphery of the connector tube. An O-ring, or other seal member **100**, is disposed in each groove **98** and mates with the interior surface of exhaust sockets **102, 104** formed in the first and second components. In this way, the seal members **100** prevent any gases from escaping from the exhaust conduit **44** to the ambient environment.

[0042] Referring to FIGS. 4 and 7, the connector component **80** includes an internal wall **106** forming a valve seat. One or more openings **108** are formed in the wall to permit passage of gases through the wall. A one-way exhalation valve member **20**, shown as a center post valve is secured to a downstream side of the wall **106**, with the valve covering the openings **108** when in a normal, closed position. The valve member **20** is preferably colored, for example a bright color, such that it is easily visible through the viewing window **114** of the connector

component **80**. The spherical shape of the viewing window **114** magnifies the appearance of the valve member **20**.

[0043] A wall or valve seat **110** is also formed in the input opening of the housing chamber between the housing chamber and the input port. Again, one or more openings **112** are formed in the wall **110** to permit the flow of gases from the input passageway into the interior space of the chamber. A one-way inhalation valve member, for example a center post valve member **18**, is secured to the downstream side of the wall **110** and covers the openings **112** when in a normal, at closed position. In other embodiments, the inhalation and exhalation valves can be configured as a duckbill valve, or other known one-way valves.

[0044] In operation, and referring to FIGS. 4 and 5, during the inhalation sequence of a breathing cycle, the ventilator **14** introduces or transmits oxygen from a gas source through the intake line **26**, input passageway and one-way inhalation valve, defined in one embodiment by the valve member **18** and valve seat **110**. A user, such as a doctor or nurse, actuates the medicament container **58** by depressing the container towards the receptacle **50**, which releases a metered dose of medicament into the interior space **6** of the holding chamber **12**. The medicament travels with the oxygen through the output opening **10** of the holding chamber and through the inhalation conduit, formed at least in part by the output passageway **36** in the outlet port **34** and the patient interface element.

[0045] During the exhalation sequence of the breathing cycle, exhaust gases are expelled from the lungs through the patient interface element back into the output port **34**. Since the one-way inhalation valve, including in one embodiment the valve member **18** and valve seat **110** positioned upstream of the output port **34**, prevents the flow of gases back into the input port **30**, the one-way inhalation valve creates a back pressure in the holding chamber **12**, thereby preventing a substantial amount of exhaust gases from entering the holding chamber **12**. Instead, a substantial amount of the exhaust gases are transmitted through the exhaust conduit **44** past the one-way exhalation valve, formed in one embodiment by the valve member **20** and valve seat **106**. As the gases pass the one-way exhalation valve, the user or care-giver monitors the viewing window **114** to

determine whether the valve member **20** is moving, thereby confirming that the system is working properly. The exhaust gases pass through the exhaust conduit **44** through the exhaust opening **48** into the input passageway **32** formed by the input port. The gases then travel through the Y-connector **24** and into the exhaust line **22** to the ventilator. Upon the next inhalation sequence of the breathing cycle, the one-way exhalation valve **20, 110** prevents the exhaust gases in the exhaust conduit **44** positioned downstream from the one-way exhaust valve **20, 110** from reentering the inhalation conduit, including the output passageway **36**. By introducing the exhaust gases into the input passageway **32**, the humidity of the exhaust gases is deposited at the connection point **28** to a humidifier filter exchanger thereby humidifying the dry gas flow coming from the intake line **26** and ventilator **14**. In this way, the relatively short exhalation conduit **44**, which is integrated into the ventilator chamber **4**, shortens the distance the exhaust gases have to travel and thereby increase the level of humidity at the input side of the housing.

[0046] A gas analyzer, shown for example in U.S. Patent No. 5,693,944, which is hereby incorporated herein by reference, can be connected to the exhaust line or Y-connector to monitor the amount of CO2 gas or other gases are flowing through the conduit. A pressure line port **118** can also be connected to the Y-connector to monitor the gas pressure in the circuit to avoid any increase in pressure due to an obstruction in the system, for example and without limitation.

[0047] Preferably, the ventilation chamber housing components **76, 78, 80** are made of a hard plastic, including for example and without limitation ABS, polypropylene, polyethylene, metal or PVC. Preferably, the valve members are made of a flexible material, including for example and without limitation polypropylene, polyethylene, silicone, thermoplastic elastomers, EPDM, and rubber. Various aspects of the ventilator circuit and components are disclosed and shown in U.S. Patent Application 10/774,751, filed February 9, 2004, the entire disclosure of which is hereby incorporated herein by reference.

[0048] One of the first and/or second components **76, 78** has a peripheral flange **116** or step that mates with the other component as the third component **80**

is sandwiched between the first and second components **76, 78**. The first and second components can be bonded, or otherwise connected for example by welding, snap-fit, or other known devices. The receptacle is preferably integrally molded with one or the other (or both) of the first and second components **76, 78**.

[0049] Referring to FIGS. 13-15, a four-piece ventilator chamber **120** is shown. An input port component **122** is connected to an input end of a holding chamber component **124**. In one embodiment, the holding chamber is formed from two pieces **126, 128**, with the MDI receptacle positioned on one of the holding chamber components. The components **126, 128** are snap-fit together with a circumferential ring **152** that fits in a corresponding groove **154**. A discharge nozzle **130** extends into an input passageway **32** and includes an orifice **56** facing downstream. The input component **122** has an exhaust opening communicating with the input passageway.

[0050] An output port **132** is connected to the output end **134** of the holding chamber. The output end includes a wall **138** having one or more openings **140** formed therethrough. The wall defines a valve seat for a one-way inhalation valve. The valve member **18** is connected to the wall on the downstream side thereof. The output port **132** has a baffle formed therein to prevent the valve member **18** from becoming dislodged and making its way to the patient, and is shown in one embodiment as a three arms **136**. The baffle includes an arm portion extending upstream to prevent the valve dislodgement.

[0051] An exhaust conduit **142** communicates with the output passageway and has a wall **144** formed at a junction thereof. The wall has one or more openings **146** formed therein to permit the passage of gases through the wall. The wall defines in part a valve seat. A one-way exhalation valve member **20** is connected to the valve seat downstream therefrom. A tubular exhaust line **148**, separate from or integral with, one or both of the input and output ports **122, 132** connects the ports and completes the exhaust conduit.

[0052] In operation, the ventilator chamber **120** operates in the same way as the embodiments shown in FIGS. 1-12. In particular, the one-way inhalation valve **138, 18** permits only one-way flow of gas and medicament to the patient,

while the one-way exhalation valve **144, 20** prevents exhaust gases from reentering the inhalation conduit downstream of the holding chamber **124**. In the embodiment of FIGS. 13-15, however, the one-way inhalation valve **138, 18** is positioned downstream of the holding chamber **124**, rather than upstream thereof. In addition, the exhaust conduit communicates directly with the input passageway and thereby provides passive humidification of the input gases entering the holding chamber.

[0053] Although the present invention has been described with reference to preferred embodiments, those skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. As such, it is intended that the foregoing detailed description be regarded as illustrative rather than limiting and that it is the appended claims, including all equivalents thereof, which are intended to define the scope of the invention.

WHAT IS CLAIMED IS:

1. A ventilator chamber for use in a ventilator circuit for administering medication to a patient, the ventilator chamber comprising:

a housing comprising:

a chamber defining an interior space having an input opening and an output opening;

an input port defining an input passageway communicating with said input opening and adapted to receive a flow of gases from a ventilator intake line;

a metered dose inhaler receptacle in fluid flow communication with said interior space;

an output port defining an output passageway and communicating with said output opening; and

an exhaust conduit communicating between and directly with said output passageway of said output port and said input passageway of input port;

a one-way inhalation valve positioned to permit one-way flow from said input passageway of said input port to said interior space of said chamber housing; and

a one-way exhaust valve located in said exhaust conduit, said one-way exhaust valve adapted to prevent a backflow of gas from said exhaust conduit into said output passageway.

2. The ventilator chamber of claim 1 wherein said input port and said output port are oriented in a substantially non-parallel relationship.

3. The ventilator chamber of claim 2 wherein said input port and said output port are oriented in a substantially perpendicular relationship.

4. The ventilator chamber of claim 1 wherein at least a portion of said chamber, said input port and said exhaust conduit are integrally formed as a one-piece unit.

5. The ventilator chamber of claim 1 wherein at least a portion of said chamber, said output port and said exhaust conduit are integrally formed as a one-piece unit.

6. The ventilator chamber of claim 1 wherein at least a portion of said chamber, said input port, said output port and said exhaust conduit are integrally formed as a one-piece unit.

7. The ventilator chamber of claim 1 wherein at least a portion of said chamber, said output port and at least a portion of said exhaust conduit are integrally formed as a first component, wherein at least a portion of said chamber, said input port, and at least a portion of said exhaust conduit are integrally formed as a second component separate from said first component, and wherein at least a portion of said exhaust conduit is formed as a third component separate from said first and second components, wherein said first and second components are connected to define said interior space of said chamber and with said third component connected between said first and second components.

8. The ventilator chamber of claim 1 wherein said exhaust conduit comprises a viewing window, wherein at least a portion of said one-way exhalation valve is visible through said viewing window.

9. The ventilator chamber of claim 1 wherein said metered dose inhaler receptacle opens into and communicates directly with said interior space.

10. The ventilator chamber of claim 9 wherein said metered dose inhaler receptacle is positioned adjacent said input opening and comprises an orifice oriented in a downstream direction.

11. The ventilator chamber of claim 9 wherein said metered dose inhaler receptacle is positioned adjacent said output opening and comprises an orifice oriented in an upstream direction.

12. The ventilator chamber of claim 1 wherein said metered dose inhaler receptacle comprises at least a first and second well.

13. The ventilator chamber of claim 12 wherein said pressurized metered dose inhaler comprises at least a first and second discharge orifice communicating with said first and second wells respectively.

14. The ventilator chamber of claim 1 wherein at least a portion of said housing is made of an antistatic material.

15. A ventilator circuit for administering medication to a patient, the ventilator circuit comprising:

a chamber housing defining an interior space having an input opening and an output opening;

an input port defining an input passageway communicating with said input opening and adapted to receive a flow of gases from a ventilator intake line;

a pressurized metered dose inhaler receptacle in fluid flow communication with said interior space;

an output port defining an output passageway communicating with said output opening; and

an exhaust conduit communicating with said output passageway of said output port and opening directly into said input passageway at an exhaust opening formed in said input port;

a one-way inhalation valve permitting one-way flow from said input passageway of said input port to said interior space of said chamber housing, said one-way inhalation valve positioned downstream from said exhaust opening; and

a one-way exhaust valve located in said exhaust conduit, said one-way exhaust valve adapted to prevent a backflow of gas from said exhaust conduit into said output passageway.

16. The ventilator chamber of claim 15 wherein said exhaust conduit comprises a viewing window, wherein at least a portion of said one-way exhalation valve is visible through said viewing window.

17. A ventilator circuit for use in administering medication to a patient, the ventilator circuit comprising:

a chamber housing defining an interior space and comprising an input opening and an output opening;

a one-way inhalation valve operative to permit a flow of gases into said interior space of said chamber housing;

an inhalation conduit communicating with said output end of said chamber, said inhalation conduit adapted to transmit medication to the patient;

an exhaust conduit communicating with said inhalation conduit, said exhaust conduit comprising a viewing window; and

a one-way exhaust valve located in said exhaust conduit, said one-way exhaust valve adapted to prevent a backflow of gas from said exhaust conduit into said inhalation conduit, wherein at least a portion of said one-way exhaust valve is visible through said viewing window of said exhaust conduit.

18. A method of assembling a ventilator chamber for use in a ventilator circuit, the method comprising:

providing a first chamber component defining at least a portion of a chamber, at least a portion of an input port and at least a portion of an exhaust conduit;

providing a second chamber component defining at least a portion of said chamber, at least a portion of an output port and at least a portion of said exhaust conduit;

providing a connector component defining at least a portion of said exhaust conduit;

disposing said connector component between said first and second chamber components; and

connecting said first and second chamber components.

19. The method of claim 18 wherein said disposing said connecting said first and second chamber components comprises connecting said first and second chamber components with at least one interfitting flange.

20. The method of claim 18 wherein said connector component comprises a viewing window and a one-way valve disposed therein, wherein at least a portion of said one-way valve is visible through said viewing window.

21. A method of administering a medication to a patient comprising:

transmitting oxygen from a gas source through an inlet line, a holding chamber and an inhalation conduit to the patient during an inhalation sequence of a breathing cycle;

introducing said medication into said holding chamber;

preventing a substantial transmission of an exhaust gas into said holding chamber during an exhalation sequence of said breathing cycle;

transmitting a substantial portion of said exhaust gas into an exhaust conduit during said exhalation sequence;

preventing a substantial transmission of said exhaust gas from said exhaust conduit into said inhalation conduit during subsequent inhalation sequences of subsequent breathing cycles; and

transmitting said exhaust gas from said exhaust conduit directly into said inlet line.

22. A medication delivery device comprising:

a holding chamber having an input end and an output end;

a metered dose inhaler receptacle in communication with said input end of said holding chamber, said receptacle comprising at least first and second wells shaped to receive respectively a valve stem of first and second metered dose inhalers.

23. The medication delivery device of claim 22 wherein said receptacle further comprises first and second outlet orifices communicating respectively with said first and second wells.

24. The medication delivery device of claim 23 wherein said first and second outlet orifices have different shapes respectively.

FIG.1

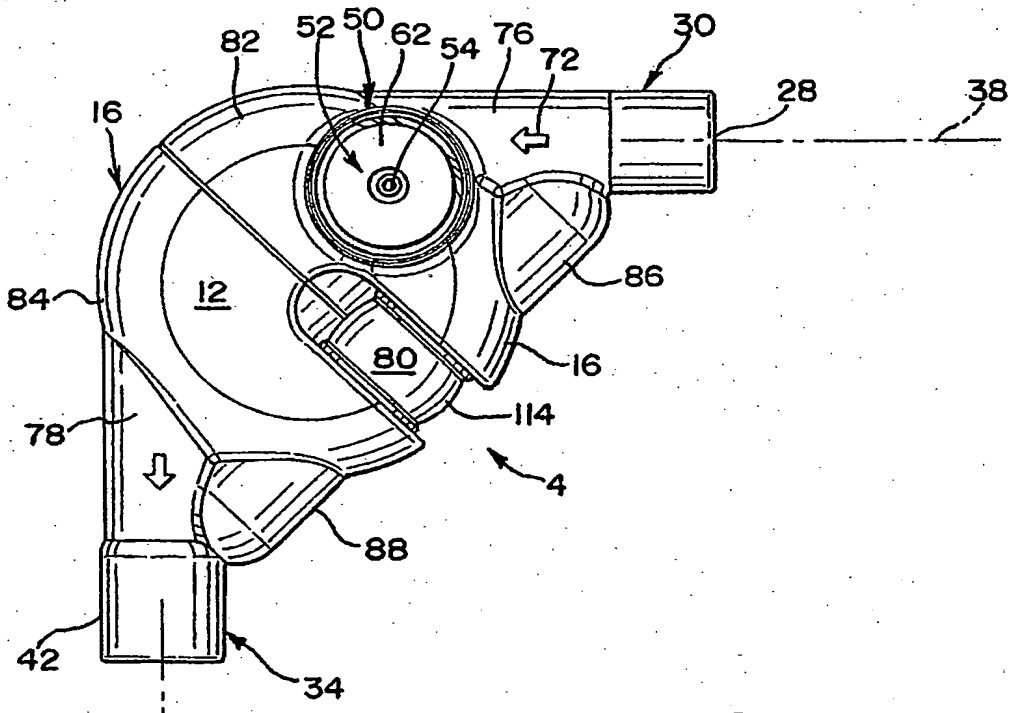
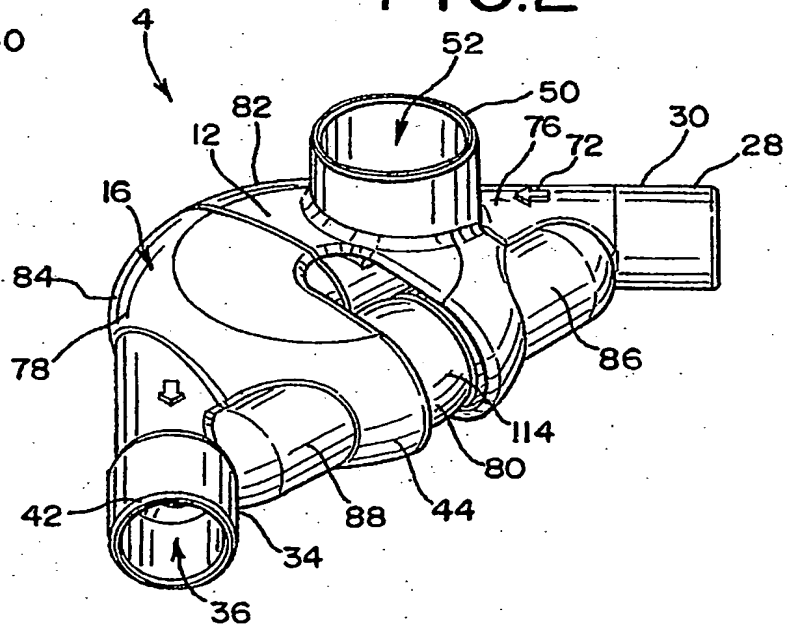


FIG.2



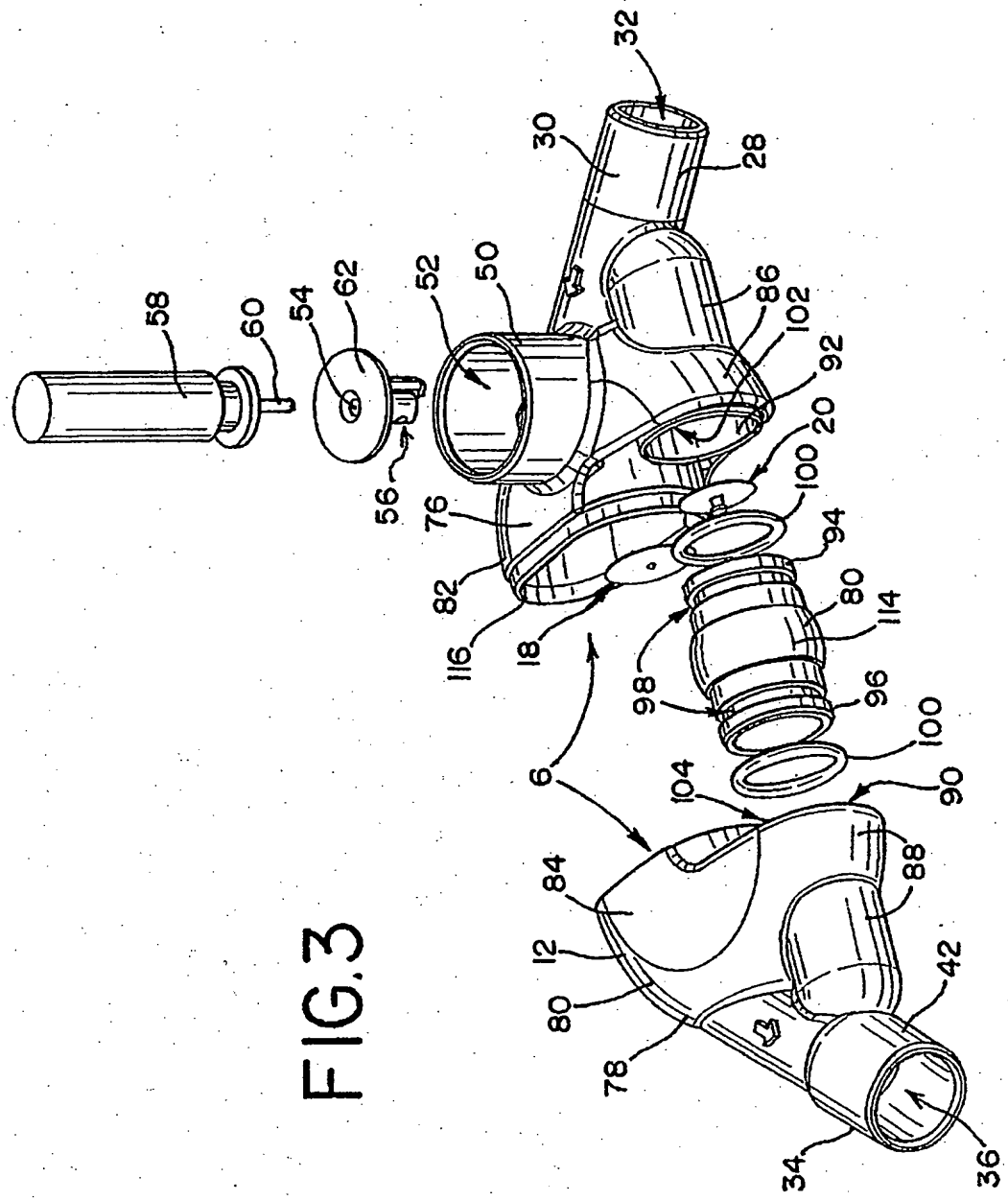


FIG.3

FIG.4

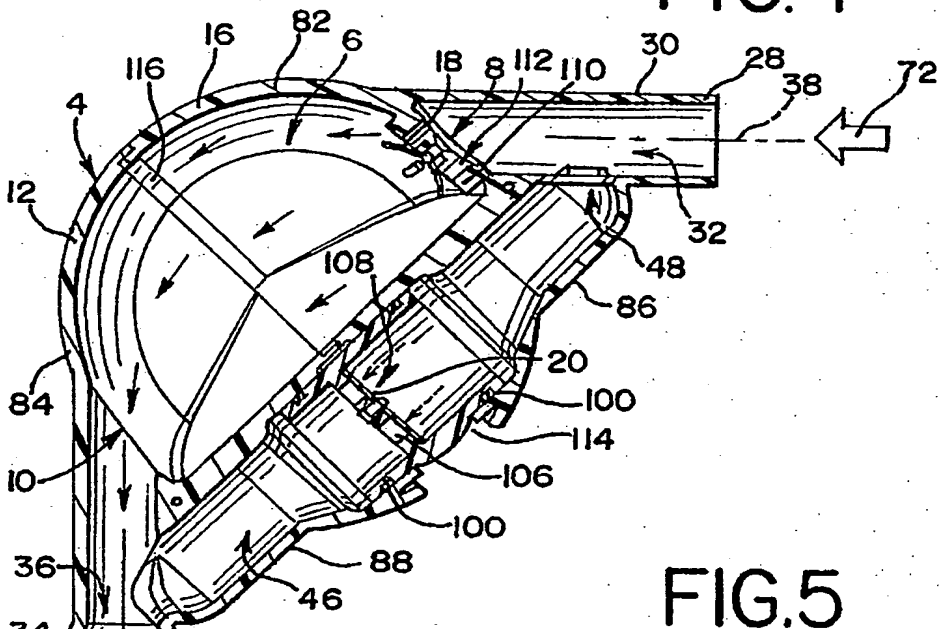


FIG.5

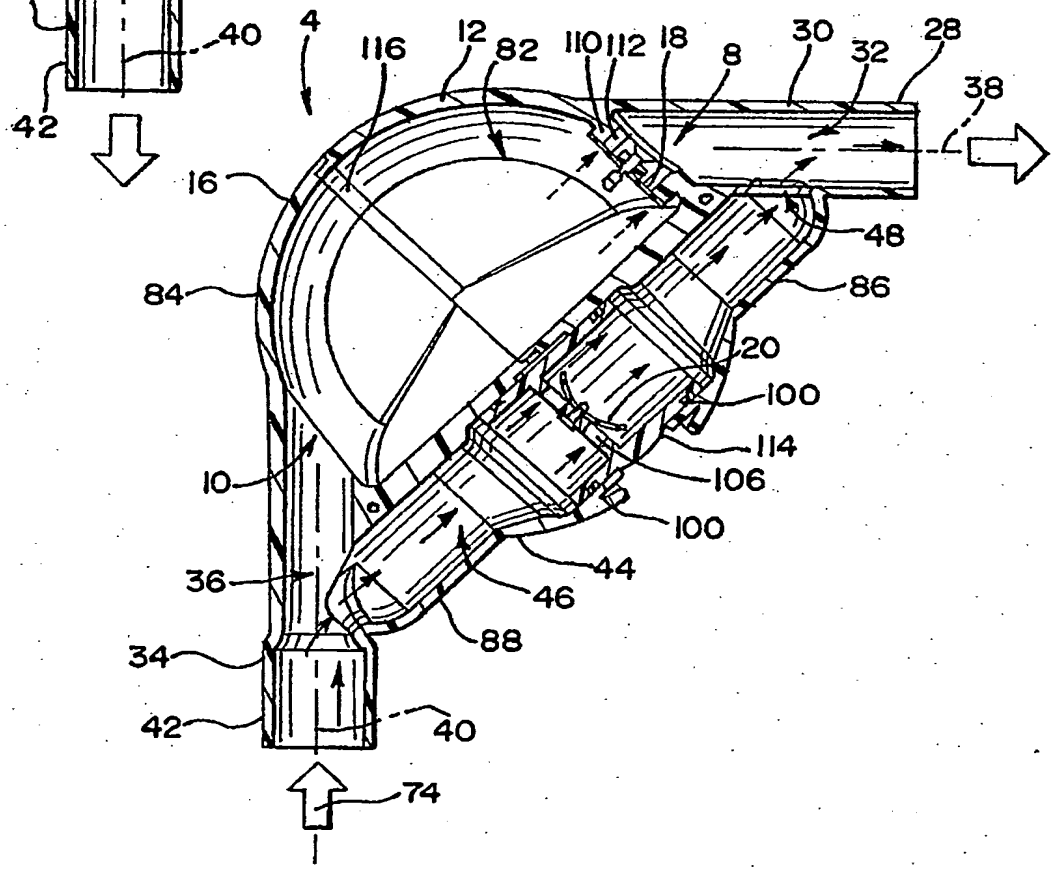


FIG.6

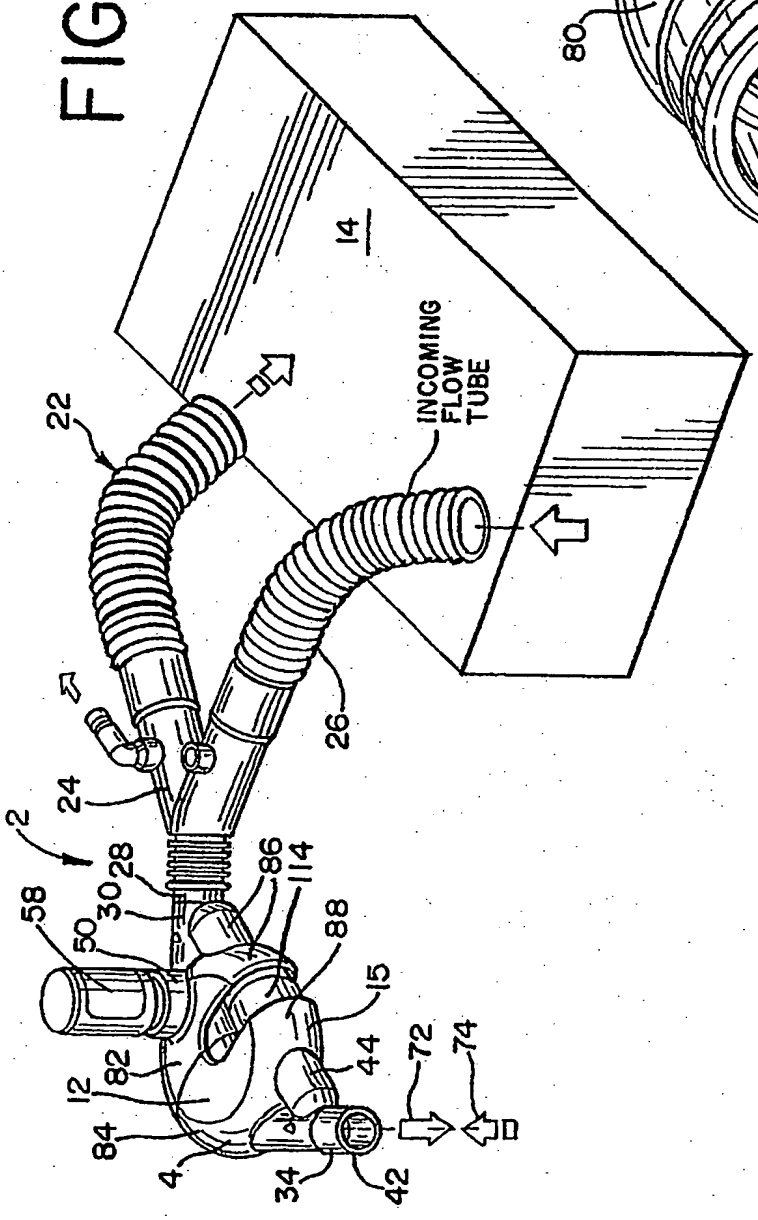


FIG.7

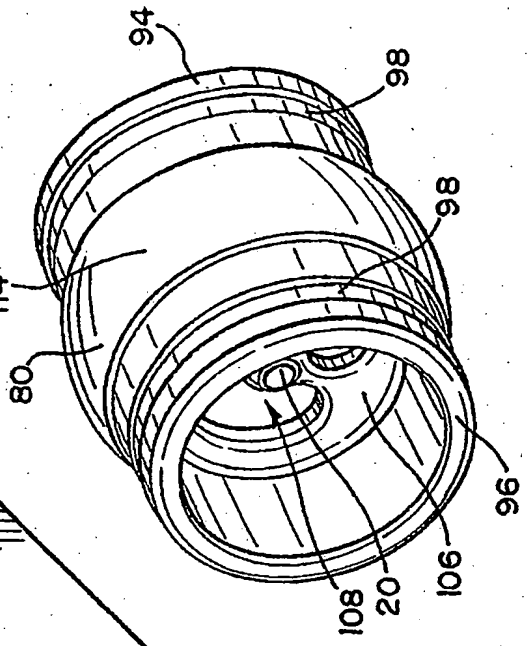


FIG. 8

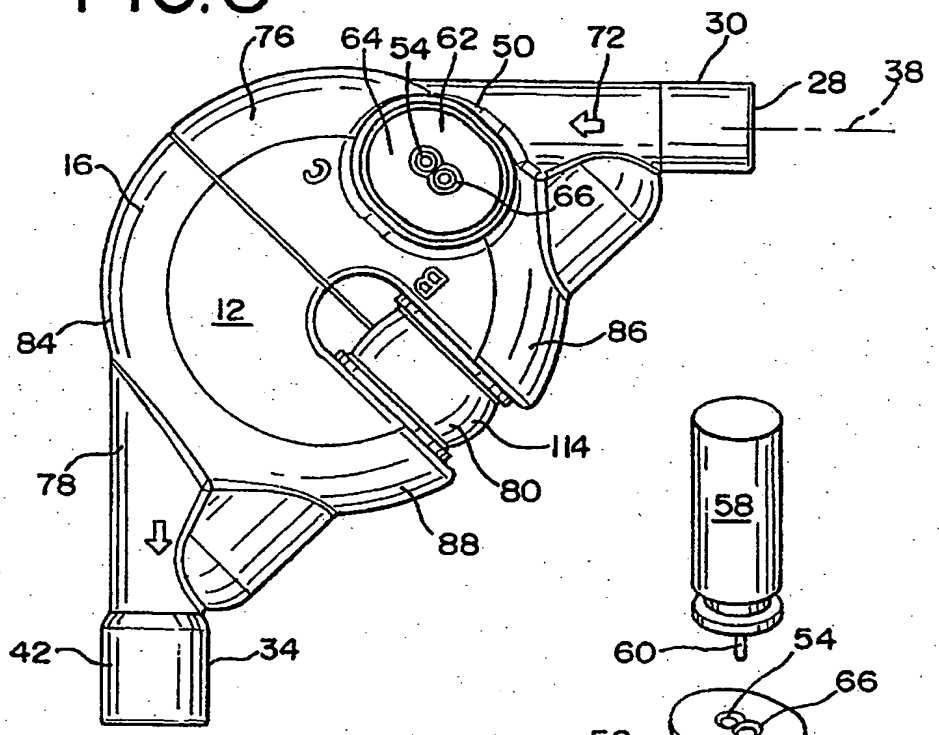


FIG. 9

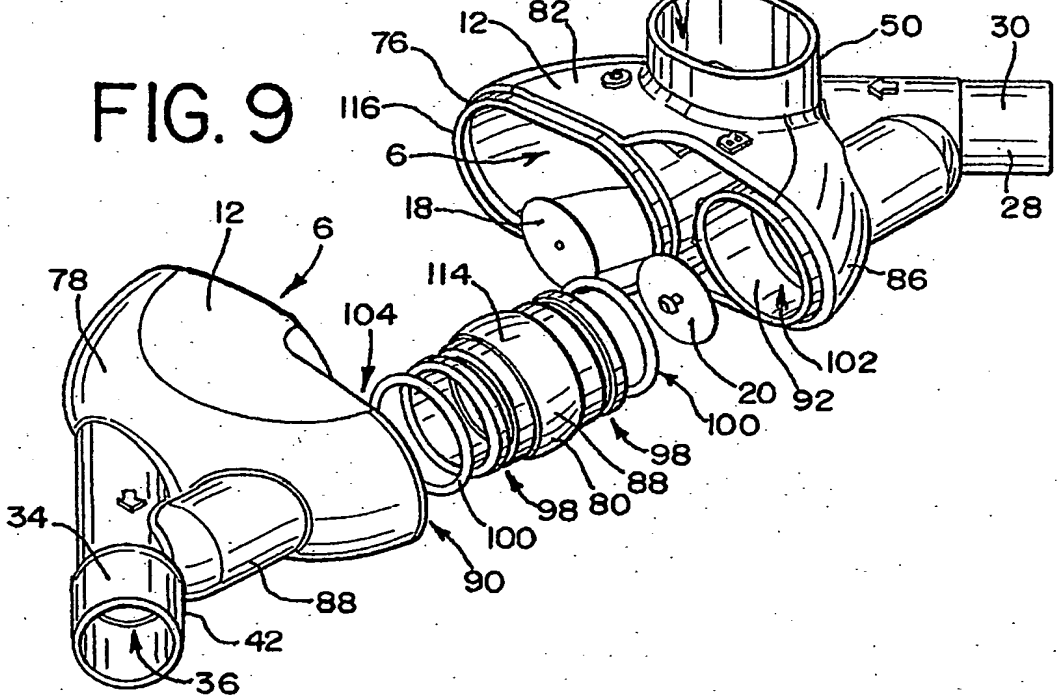


FIG.10

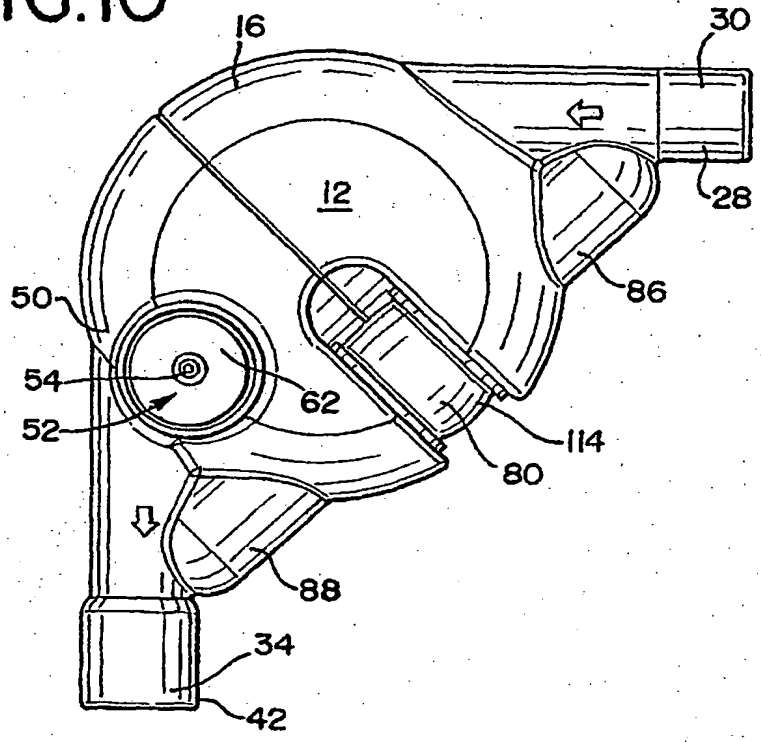
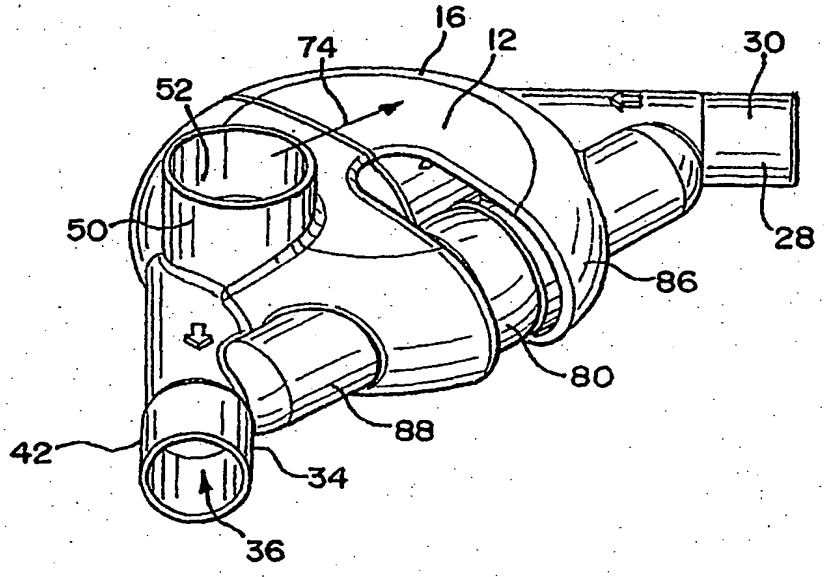


FIG.11



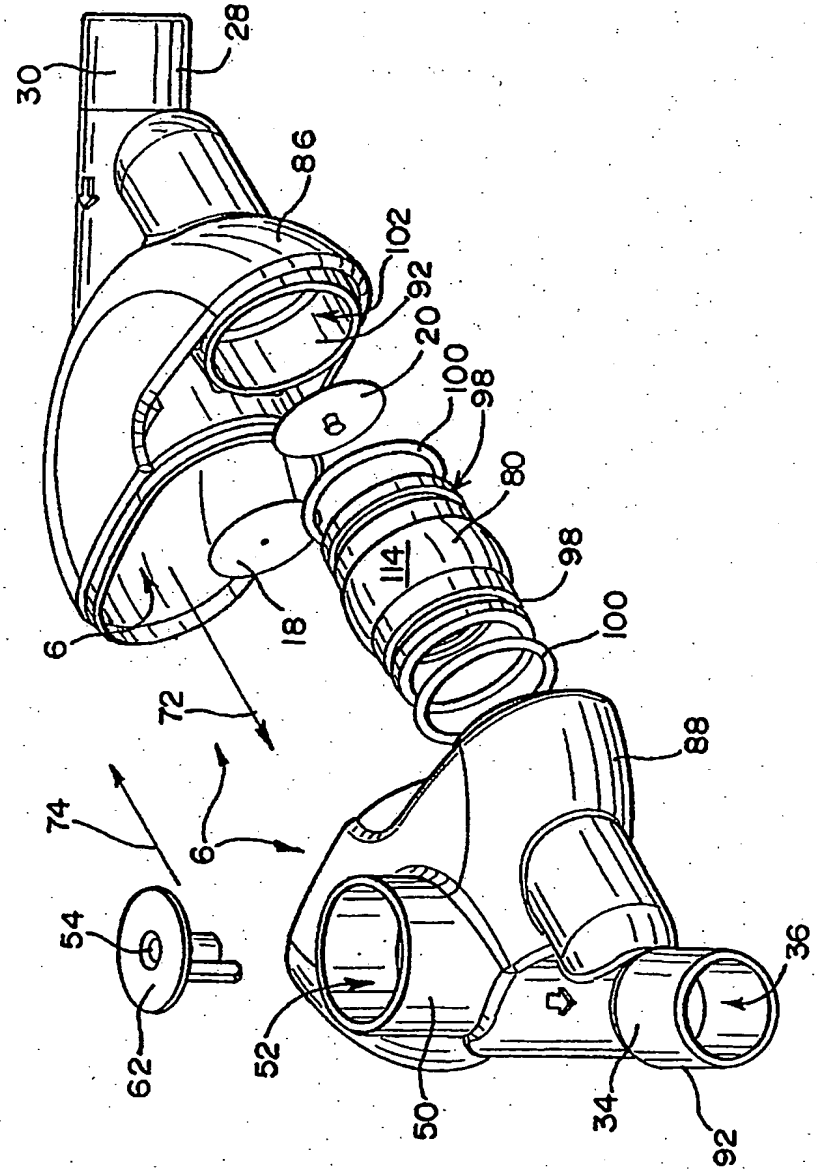


FIG. 12

FIG. 13

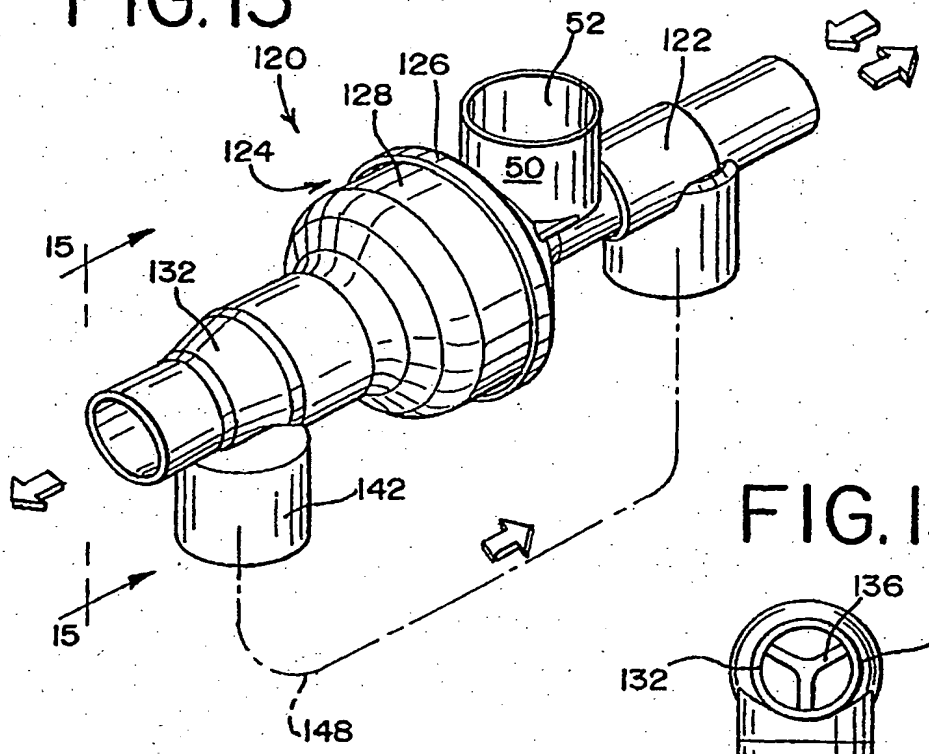
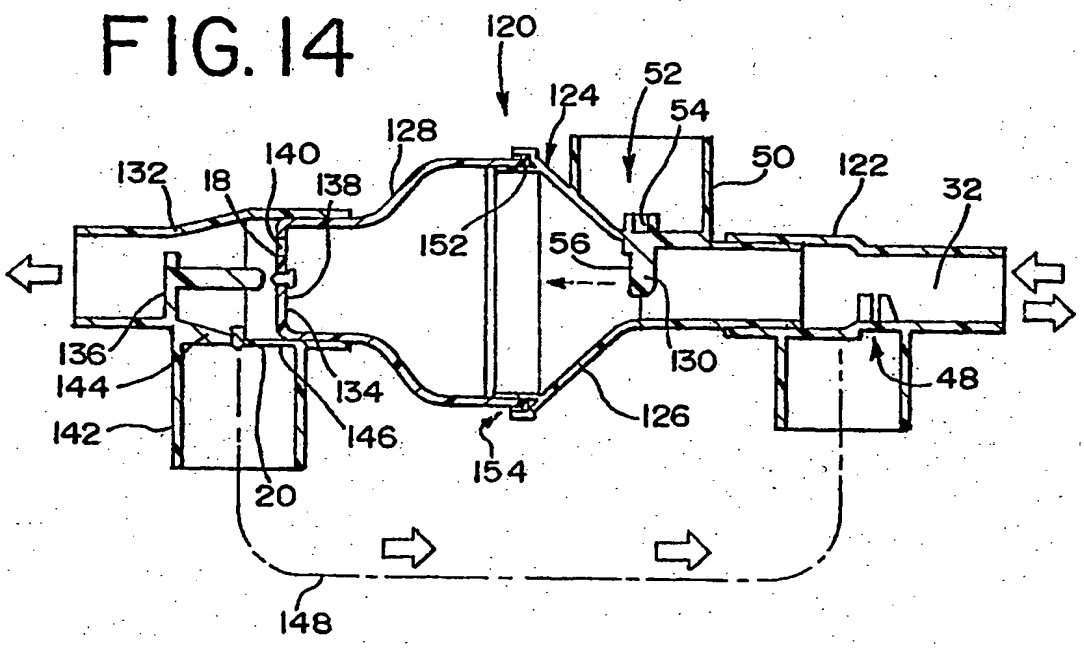


FIG. 15

FIG. 14



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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

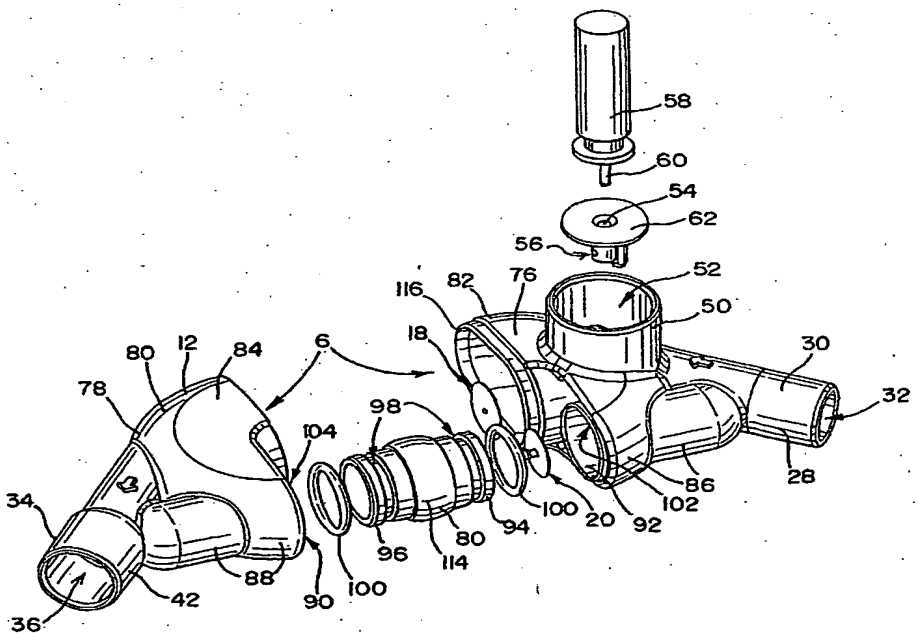
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(88) Date of publication of the international search report:
28 December 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: VENTILATOR CIRCUIT AND METHOD FOR THE USE THEREOF



(57) Abstract: A ventilator circuit for use in administering medication to a patient includes a housing, a one-way inhalation valve and a one-way exhalation valve. A metered does inhaler receptacle is in fluid flow communication with an interior space of the housing holding chamber. An exhaust conduit communicates between input and output passageways disposed on opposite sides of the interior space.

WO 2006/114699 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2006/001027

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A61M 15/00*** (2006.01) , ***A61M 11/00*** (2006.01) , ***A61M 16/00*** (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (2006.01): A61M 15/00, 11/00, 16/00; CPC: 128/64, /71-73; USPC: 128/200.23, /204.18; ECLA: A61M 15/00K 15/00P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
CPD; WEST, Delphion, Espacenet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	CA 2 515 593 A1 (GRYCHOWSKI et al) 26 August 2004 (26-08-2004) *the whole document*	1 to 6, 8 to 11 and 15 to 20 12 to 14
X, P	US 2005/0217667 A1 (DHUPER et al) 06 October 2005 (06-10-2005) *the whole document*	1 to 20
X	CA 2 329 126 (WATT) 28 October 1999 (28-10-1999) *page 34, line 20 to page 37, line 17; figures 3 and 4*	17
X	CA 2 424 731 (FARMER) 07 October 2004 (07-10-2004) *the whole document*	17
Y	CA 2 354 561 (RAO et al) 15 June 2000 (15-06-2000) *the whole document*	14

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 August 2006 (22-08-2006)	21 September 2006 (21-09-2006)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476	Authorized officer Kristian Ewen (819) 934-4269

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 002 048 (MAKIEJ, Jr.) 26 March1991 (26-03-1991) *the whole document*	22 to 24 12 and 13
X Y	CA 2493 078 (DAVIES) 05 February 2004 (05-02-2004) *the whole document*	22 to 24 12 and 13
X Y	CA 2 210 721 (DWORK) 25 July 1996 (25-07-1996) *the whole document*	22 to 24 12 and 13
A	EP 0 281 650 A1 (BRUGGER) 14 September 1988 (14-09-1988) *the whole document*	1 to 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2006/001027

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. [X] Claim Nos. : 21

because they relate to subject matter not required to be searched by this Authority, namely :

Claim 21 is considered to be directed to a method of medical treatment which the International Search Authority is not required to search under PCT Article 17(2)(a)(i) and PCT Rule 39.1(iv). Consequently, no search has been carried out for aforesaid claim.

2. [ ] Claim Nos. :

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

3. [ ] Claim Nos. :

because they are dependant claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

The claims are directed to a plurality of inventive concepts as follows:

Group A - Claims 1 to 20 are directed to inhalation and exhalation features of a ventilation circuit or chamber.

Group B - Claims 22 to 24 are directed to a medication delivery device configured to receive a plurality of metered dose inhalers

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [X] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
CA2515593	26-08-2004	EP1596918 A2	23-11-2005
		MXPA05008518 A	17-11-2005
		US2005039746 A1	24-02-2005
		WO2004071549 A2	26-08-2004
US2005217667	06-10-2005	WO2005097242 A2	20-10-2005
CA2329126	28-10-1999	AU735077B B2	28-06-2001
		AU3322999 A	08-11-1999
		AUPP305498D D0	14-05-1998
		AUPP400198D D0	02-07-1998
		AUPP660198D D0	12-11-1998
		CN1301187 A	27-06-2001
		EP1073490 A1	07-02-2001
		JP2002512092T T	23-04-2002
		NZ507661 A	26-11-2002
		US6578571 B1	17-06-2003
		WO9953982 A1	28-10-1999
		ZA200005791 A	05-02-2002
CA2424731	07-10-2004	US6494202 B2	17-12-2002
		US6584969 B2	01-07-2003
CA2354561	15-06-2000	AT304873T T	15-10-2005
		AU2945999 A	26-06-2000
		DE69927402D D1	27-10-2005
		DE69927402T T2	26-01-2006
		DK1137452T T3	14-11-2005
		EP1137452 A1	04-10-2001
		ES2249886T T3	01-04-2006
		US2004094148 A1	20-05-2004
		WO0033902 A1	15-06-2000
		ZA9811257 A	17-10-2000
US5002048	26-03-1991	NONE	

CA2493078	05-02-2004	AU2003250166 A1	16-02-2004
		AU2003254590 A1	16-02-2004
		AU2003281751 A1	16-02-2004
		BR0306799 A	07-12-2004
		BR0312725 A	19-04-2005
		CA2473053 A1	31-07-2003
		CN1622838 A	01-06-2005
		CN1671435 A	21-09-2005
		EP1467789 A1	20-10-2004
		EP1467790 A1	20-10-2004
		EP1525018 A1	27-04-2005
		EP1534367 A1	01-06-2005
		EP1534368 A1	01-06-2005
		GB0201677D D0	13-03-2002
		GB0217199D D0	04-09-2002
		GB0227145D D0	24-12-2002
		IL162700D D0	20-11-2005
		JP2005515039T T	26-05-2005
		JP2005527260T T	15-09-2005
		JP2005533581T T	10-11-2005
		JP2005533582T T	10-11-2005
		JP2005533583T T	10-11-2005
		MXPA04007129 A	29-10-2004
		MXPA05001026 A	16-05-2005
		NO20043521 A	22-10-2004
		NZ533780 A	31-03-2006
		PL371862 A1	27-06-2005
		US2005154491 A1	14-07-2005
		US2005247312 A1	10-11-2005
		US2005251289 A1	10-11-2005
		US2005268908 A1	08-12-2005
		WO03061743 A1	31-07-2003
		WO03061744 A1	31-07-2003
		WO2004011067 A1	05-02-2004
		WO2004011068 A1	05-02-2004
		WO2004011069 A1	05-02-2004
		ZA200405701 A	03-10-2005
CA2210721	25-07-1996	AU4373596 A	07-08-1996
		EP0956064 A1	17-11-1999
		US5522380 A	04-06-1996
		WO9622119 A1	25-07-1996
EP0281650	14-09-1988	AT72997T T	15-03-1992
		DE3777157D D1	09-04-1992
		DE8703534U U1	06-08-1987